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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/003,358	11/14/2001	Fang-Cheng Chang	NTI-022	4650
29477	7590	08/11/2004	EXAMINER	
BEVER HOFFMAN & HARMS, LLP 1432 CONCANNON BLVD BLDG G LIVERMORE, CA 94550-6006			LIN, SUN J	
			ART UNIT	PAPER NUMBER
			2825	

DATE MAILED: 08/11/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/003,358

Applicant(s)

CHANG, FANG-CHENG

Examiner

Sun J Lin

Art Unit

2825

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 14 November 2001.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-27 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-27 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 11/14/2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☐ All    b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date <u>2</u> . | 6) <input type="checkbox"/> Other: _____  |

### **DETAILED ACTION**

1. This office action is in response to application 10/003,358 filed on 11/14/2001.  
Claims 1 – 27 remain pending in the application.

### ***Specification Objections***

2. The specification is objected to because of following informalities:  
Paragraph 0004, line 4, change "location" to —locations—. Appropriate correction is required.

### ***Claim Objections***

3. Claims listed below are objected to because of the following informalities:  
Claim 1, line 6, in front of "inspection" insert —the—. Claim 1, line 6, change "images" to —image—. Claim 6, line 6, delete —wafer—.

Appropriate correction is required.

### ***Claim Rejections - 35 USC § 103(a)***

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

- (1). Determining the scope and contents of the prior art.
- (2). Ascertaining the differences between the prior art and the claims at issue.
- (3). Resolving the level of ordinary skill in the pertinent art.
- (4). Considering objective evidence present in the application indicating obviousness or nonobviousness.

5 Claims 1 – 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 6,272,236 B1 to Pierrat et al. in view of U.S. Patent No. 6,057,063 to Liebmann et al.

6. As to Claim 1, Pierrat et al. show and teach the following subject matter:

- Image simulation procedures capable of detecting anticipate defects on a mask – [col. 3, line 14 – 26]; capturing (i.e., generating) inspection image of a portion (e.g., critical feature) of the mask and creating a simulation of resist to be formed (on a wafer) according to the inspection image – [col. 3, line 49 – 51]; Notice that the portion of mask containing a critical feature, which requires special attention, is an area of interest (AOI); Therefore, an AOI (area of mask containing a critical feature portion) is identified first, and then an inspection image of the critical feature portion in the AOI is generated for use in the simulation;
- Mask pattern is manufactured from original (design) pattern data – [col. 3, line 45 – 46];
- Mask inspection machine can be applied to any particular type of masks, which include photomask and phase shifting mask – [col. 6, line 19 – 27]; Notice that a photomask is designed for a desired design pattern, including a critical feature portion in an AOI, it is manufactured utilizing original (design) pattern data – [Fig. 3]; Pattern data is a geometry information regarding desired pattern design. Photomask is a design geometry information.

Pierrat et al. do not disclose information about construction of phase shifting mask and its relationship with a (critical) feature. But Liebmann et al. show and teach the following subject matter:

- A process for creating and verifying a design of phase-shifted mask – [title; abstract];
- Phase-shifted masks are deployed to (critical) features in a chip design that require phase shifting – [abstract; col. 3, line 59 – 62];
- Phase-shifted mask contains colored phase regions, which are created on opposite sides of features – [abstract; Fig. 1 – Fig. 4]; Proper phase termination (e.g., 180° out of phase) of the phase regions is ensured based upon space constraints of a phase-shifted mask technique utilized – [abstract].

In addition, Liebmann et al. also teach that phase shifted mask (PSM) lithography is applied to improve the lithographic process latitude in order to replicate small image (i.e., critical feature) in a chip design – [col. 2, line 34 – 56].

Therefore, it would have been obvious at the time the invention was made to a person having ordinary skill in the art to have applied the teachings of Liebmann et al. in utilizing phase shifted mask to improve the lithographic process latitude in order to replicate small image (i.e., critical feature) in the AOI.

Notice that Liebmann et al. also show and teach the following subject matter:

- a photomask design showing (critical) feature edges – [Fig. 1];
- phase regions of phase shifted masks, which are deployed around the photomask of each (critical) feature edges – [Fig. 2];

Therefore, in order to appropriately deploy the appropriate phase regions of a phase shifting mask around an AOI having a critical feature, the photomask (design geometry information) regarding an area outside the AOI should be provided and modified to accommodate the phase regions.

Combining the teachings of Liebmann et al. and Pierrat et al., the following subject matter is disclosed utilizing Fig. 1 of Pierrat et al.:

- Simulation of a critical feature in the AOI is performed based on the inspection image of the AOI and the phase regions of a phase shifting mask deployed around the AOI according to design geometry information (photomask) in Step 180 – [Fig. 1]; Notice that the image simulation of desired design pattern of the critical feature under study is performed in Step 185.

For reference purposes, the explanations given above in response to Claim 1 are called **[Response A]** hereinafter.

7. As to Claim 18, reasons are included in **[Response A]** given above.

8. As to Claim 27, reasons are included in **[Response A]** given above. Notice that based on the explanations included in **[Response A]**, a computer program product can be generated to perform the subject matter as recited in Claim 27.

9. As to Claim 25, reasons are included in **[Response A]** given above. Notice that accuracy of the critical feature is based on the following factors:

- a mask inspection image, which has a defined area (i.e., area defined the critical feature); and
- design geometry information (photomask) outside the defined area, where appropriate phase regions of phase shifting mask are deployed around the defined area.

For reference purposes, the explanations given above in response to Claim 25 are called **[Response B]** hereinafter.

10. As to Claims 2 and 19, modifying data include colors and layout data of phase regions for use in the phase shifting mask around the critical feature in the AOI in order to achieve appropriate phase shifting. Notice that the colors of phase regions are set to control the degree of phase shifting (e.g., 180° out of phase) between the phase regions.

11. As to Claims 3 and 20, modifying data includes **generating phase regions** of phase shifting mask outside and around the AOI and **combining** the inspecting image of critical feature and the phase regions of phase shifting mask. Notice that an image generated by the phase regions of phase shifting mask is a phase shifting image, which is a virtual image.

For reference purposes, the explanations given above in response to Claims 3 and 20 are called **[Response C]** hereinafter.

12. As to Claim 4, as explained in **[Response A]** given above, the simulation 180 is performed on the combined images 160.2, which is a combination of the inspecting image and the image of phase regions of phase shifting mask received from Step 130 – [Fig. 1].

For reference purposes, the explanations given above in response to Claim 4 are called **[Response D]** hereinafter.

13. As to Claims 5, 6 and 21, reasons are included in **[Response C]** and **[Response D]** given above.

14. As to Claims 7 and 22, *Pierrat et al.* show and teach that the photomask (design geometry information) of an entire original pattern design can be digitized to acquire an inspection data (digitized image data), which is sent to image simulation circuitry – [Fig. 1; Fig. 3; col. 5, line 45 – 50]. Notice that a digitized image is a bit map image, which is made of bits “1” and bit “0”.

For reference purposes, the explanations given above in response to Claims 7 and 22 are called **[Response E]** hereinafter.

15. As to Claims 8 and 23, the design geometry information of a photomask of an entire original pattern design includes a (critical) feature in an AOI. Therefore, the design geometry information of a photomask of an entire original pattern design includes extending geometries of the (critical) feature in the AOI – [*Liebmann et al.*; Fig. 1 – Fig. 5].

16. As to Claims 9 and 10, as explained in **[Response A]** given above, providing design geometry information (photomask) includes accessing information regarding another mask, which is a phase shifting mask – [*Liebmann et al.*; Fig. 1 – Fig. 5].

For reference purposes, the explanations given above in response to Claims 9 and 10 are called **[Response F]** hereinafter.

17. As to Claim 24, reasons are included in **[Response F]** given above. Notice that, in design of an appropriate phase shifting mask, database information regarding phase shifting (i.e., colors) and sizes for use in design of phase regions of the phase shifting mask needs to be accessed.

For reference purposes, the explanations given above in response to Claims 9 and 24 are called **[Response G]** hereinafter.

18. As to Claim 26, in addition to reasons included in [Response A], [Response B], [Response C], and [Response D] given above, Liebmann et al. and Pierrat et al. show and teach the following subject matter:

- (Photomask) image simulation obtained in Step 185 is based on desired pattern database, it provides a first accuracy – [Pierrat et al. – Fig. 1];
- Mask inspection image with phase shifting mask generated in Step 180 provides an improved accuracy – [Pierrat et al. – Fig. 1; Liebmann et al., col. 2, line 34 – 40];
- Improved accuracy of image simulation 180 is compared with first accuracy in image simulation 185 to detect defect in 140 – [Pierrat et al. – Fig. 1].

19. As to Claim 11, in addition to reasons included in [Response A] and [Response G] given above, Pierrat et al. teach that the inspection image is a digitized image generated from an inspection tool (e.g., scanning electron microscope SEM) – [col. 5, line 8 – 18; col. 5, line 45 - 50]. Notice that the Inspection image is first information relating to a first area (i.e., AOI) – [Response A]. Second information is obtained from design geometry information (i.e., design file). The Second information is related to area of phase region (i.e., second area) of phase shifting mask outside the first area (AOI) – [Response G].

20. As to Claim 12, reasons are included in [Response E] given above.

21. As to Claims 13 and 14, Liebmann et al. show in Fig. 1 and Fig. 2 and teach that the second area (phase region) for use in designing a phase shifting mask is defined by a predetermined spacing (i.e., distance) or a plurality of spacings (i.e., distances) from a perimeter of the first area (i.e., feature edge under study) dependent upon structure and size of the critical feature edge in the first area.

22. As to Claim 15, the first area is a feature in any AOI. The first area (feature) can be defined by an engineer (i.e., user) by choosing an AOI when operating the simulation engine.

23. As to Claim 16, Liebmann et al. teach the following subject matter:



- Phase shifted mask design system for manufacturing VLSI circuit device – [abstract];
- Mask process for creating and verifying a design of phase shifted mask utilizing at least one phase shift region employing a computer-aided design system – [abstract]; Notice that the phase shifted mask design system is a computer-aided design system; The second area (phase region) can be defined by the phase shifted mask design system
- Critical features in a design of the phase shifted mask (for a VLSI circuit device) that required phase shifting are located – [abstract]; Notice that the first area (i.e., critical feature) is located (i.e., defined) by the phase shifted mask design system.

24. As to Claim 17, as explained in [Response A] given above, the first area relates to photomask (i.e., first mask) of a desired pattern of a critical feature and the second area (phase regions) relates to phase shifting mask (i.e., second mask) associated with the photomask (first mask).

### Conclusion

25. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Sun J. Lin whose telephone number is (571) 272-1899. The examiner can normally be reached on Monday-Friday (9:00AM-6:00PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Smith can be reached on (571) 272-1907. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9318 for regular communications and (703) 872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-1782.

Sun James Lin  
Art Unit 2825  
August 9, 2004

